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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Blaise DIDILLON et al.

Examiner: Griffin, Walter Dean

Serial No.: 09/819,949

Group Art Unit: 1764

Filed: March 29, 2001

Title: PROCESS OF DESULPHURIZING GASOLINE COMPRISING
DESULPHURIZATION OF THE HEAVY AND INTERMEDIATE FRACTIONS
RESULTING FROM FRACTIONATION INTO AT LEAST THREE CUTS

BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Honorable Commissioner for Patents
and Trademarks

Sir:

Further to the Notice of Appeal filed May 24, 2004, attached herewith are three copies of Appellants' Brief on Appeal. The attached check includes the \$330.00 fee for the filing of this Brief.

This is an appeal from the decision of the Examiner finally rejecting claims 11-21 and 23-46.

(1) REAL PARTY IN INTEREST

The application is assigned of record to Institut Francais Du Petrole, who is the real party in interest herein. The assignment is recorded in Reel 011959/Frame 0596.

(2) RELATED APPEALS AND INTERFERENCES

Appellants, their legal representative and the assignee are not aware of any related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the instant appeal.

(3) STATUS OF THE CLAIMS

Claims rejected: 11-21 and 23-46

Claims allowed: None

Claims canceled: 1-10 and 22

Claims withdrawn: None

Claims objected to: None.

Claims on Appeal: 11-21 and 23-46. A copy of the claims on appeal is provided in the attached Appendix.

(4) STATUS OF AMENDMENTS AFTER FINAL

Subsequent to the Final Rejection in the Office Action of December 23, 2003, Appellants filed a Reply under 37 CFR §1.116 on April 23, 2004, in which claim 36 was amended. No further amendments have been submitted.

In the Advisory Action issued May 10, 2004, the Examiner indicated that the amendment would be entered, and that the rejection of claim 36 under 35 USC 112, second paragraph was withdrawn. But, the prior art rejections as to claims 11-21 and 23-46 were maintained. Also, the Advisory Action indicates that claim 36 is rejected under 35 USC §103 in view of the Carruthers et al. (US 3,691,066), Hatanaka et al. (EP 0 725 126), and Cecil et al. (US 3,732,155).

(5) SUMMARY OF THE INVENTION

The invention relates to a process of producing gasoline having low sulphur content from a feedstock containing sulphur. The process comprises: at least one selective hydrogenation of diolefins and acetylenic compounds within the feedstock; at least one separation of the gasoline obtained from the selective hydrogenation into at least three fractions; at least one treatment of a heavy gasoline fraction from the separation with a catalyst to at least partially decompose or hydrogenate unsaturated sulphur compounds; and at least one removal of sulphur and nitrogen from at least one intermediate fraction from the separation. See, e.g., the Abstract and independent claims 11, 25-27, 29, 30, and 46.

(6) ISSUES

The issues on Appeal are:

- (1) whether claims 11, 12, 16-19, 21, 23-25, 28-35, 37-40, 45 and 46 of the application are unpatentable under §103 as being obvious in view of the disclosure of Carruthers et al. (US 3,691,066) and Hatanaka et al. (EP 0 725 126); and
- (2) whether claims 13-15, 20, 26, 27, 36, and 41-44 of the application are patentable under 35 U.S.C. §103 as being obvious in view of the disclosure of Carruthers et al. (US 3,691,066), Hatanaka et al. (EP 0 725 126), and Cecil et al. (US 3,732,155).

(7) GROUPING OF THE CLAIMS

Claims 11, 25, 26, 27, 29, 30, and 46 are independent claims and do not stand or fall together. Claims 16, 17, 21, 35-37, 38, 39, and 40 do not stand or fall with the rejection of claim 11, and are argued separately below. Claims 14-15, 20, 36, and 41-44 not stand or fall with the rejection of claim 13, and are argued separately below.

(8) APPELLANTS' ARGUMENTS

(A) Rejection under 35 USC §103 in view of Carruthers et al. and EP '126

Claims 11, 12, 16-19, 21, 23-25, 28-35, 37-40, 45 and 46 are rejected as allegedly being obvious in view of Carruthers et al. (US 3,691,066) and EP 0 725 126. Appellants' respectfully traverse this rejection.

Carruthers et al. discloses a selective hydrogenation process wherein a hydrocarbon feedstock containing diolefins, mono-olefins, aromatics and sulfur compounds is used. The diolefin content of the feedstock is 4-35% by weight and the sulfur content is 0.01-1.5% by weight, in which 10-300 ppm by weight of the sulfur content is mercaptan sulfur. In the selective hydrogenation, the feedstock along with hydrogen is passed over a supported nickel catalyst, at a temperature of 50-250°C, a pressure of 200-3,000 psig, a space velocity of 0.2-10 v/v/hour and a hydrogen treating rate of 1,504 to 37,600 mol/m³. The resultant

product is said to exhibit a reduced diolefin content of below 0.5% by weight and a reduced mercaptan content of below 30 ppm by weight, preferably below 10 ppm by weight. It is disclosed that the feedstock can be hydrogenated over a nickel catalyst without significant sulfur poisoning and that this finding is believed to be due to the mercaptans reacting with olefins during hydrogenation to yield thiophenes. See Column 2, lines 19-53.

Thus, Carruthers et al. simply discloses a selective hydrogenation of hydrocarbon fraction which contains diolefins, mono-olefins, aromatics and sulfur compounds.

Carruthers et al.'s process is directed toward taking advantage of a finding that selective hydrogenation over a nickel catalyst of a feedstock with a relative high amounts of mercaptans can occur when the mercaptans are caused to react with diolefins to form thiophenes. See column 2, lines 8-35. The reduction of mercaptans prevents poisoning of the catalyst and is said to improve the quality of the product. See column 3, lines 13-15. As stated by Carruthers et al., the object is to reduce diolefin content so as to render the product stable. See column 3, lines 1-4.

No indication can be gleaned from the Carruthers et al. disclosure of subjecting the effluent from the process to a separation step. Of course, Carruthers et al. also does not disclose or suggest any steps to treat the fractions coming from a separation step, since no separation is suggested.

Thus, Carruthers et al. makes no disclosure or suggestion of subsequent treatment of the effluent from the selective hydrogenation such as by subjecting the effluent to a separation step to provide at least three fractions, a light fraction, a heavy fraction and at least one intermediate fraction. Compare Appellants' claims 11, 25, 29, 30, and 46. Similarly, Carruthers et al. provides no suggestion of subjecting a heavy fraction from the effluent of the selective hydrogenation to a catalytic procedure whereby sulfur compounds are at least partially decomposed or hydrogenated. Compare Appellants' claims 11, 25, 29, and 46.

The product effluent from Carruthers et al.'s process is intended to be stable. Carruthers et al. specifically discloses that it can be used as a gasoline component. Alternatively, Carruthers et al. discloses that the product can be subjected to further hydrogenation in order to achieve complete saturation of mono-olefins. Carruthers et al.

provides no motivation that would lead one of ordinary skill in the art to subject the product to any separation process, such as the one disclosed by Hatanaka et al. (EP '126), and then subject the resultant separated fractions to further treatments.

Carruthers et al. discloses that its reduction in mercaptans improves quality.

Carruthers et al. does not disclose or suggest any further steps to treat/remove any sulfur compounds. For example, there is no suggestion of separating the effluent into a light fraction, from which substantially all sulfur compounds are removed, and a heavy fraction, containing most of the initial sulfur compounds, and then subjecting the heavy fraction to a catalytic procedure whereby sulfur compounds are at least partially decomposed or hydrogenated. Compare Appellants' claims 11, 25 and 46.

Carruthers et al. also fails to suggest separating the hydrogenation effluent into at least three fractions, and removing sulfur and nitrogen from at least one of the separated fractions. Compare Appellants' claims 11, 25, 30, and 46.

Further, as noted above, the hydrogen treating rate in the process of Carruthers et al. is 1504-37,600 mol/m³. This corresponds to 36-902 liters hydrogen per liter of feedstock. Compares, e.g., Appellants' claims 11, 25, 29, and 30. Furthermore, in comparison to the hydrogen treating rate, Carruthers et al. discloses that the hydrogen consumption rate is typically much lower, i.e., 1128-3,760 mol/m³. See column 3, lines 18-21. Thus, Carruthers et al. clearly suggests using an excess of hydrogen.

In the Office Action of December 23, 2003, the Examiner argues that the hydrogen consumption rates in the Carruthers et al. process are within the hydrogen feed rate recited in Appellants' claims, and that it would be obvious to use a hydrogen feed rate equivalent to the hydrogen consumption rate. But, this is not what Carruthers et al. teaches. Instead, Carruthers et al. clearly and undeniably teaches using an excess of hydrogen. The alleged modification stated by the Examiner contradicts the teaching of Carruthers et al. Thus, there is no motivation for making the modification asserted by the Examiner.

In the Advisory Action of May 10, 2004, the Examiner asserts that it would be obvious to one of ordinary skill in the art to modify the process of Carruthers et al. to reduce the hydrogen treating rate to within the hydrogen consumption range in order to reduce hydrogen costs. Yet, nothing within the disclosure of Carruthers et al. or Hatanaka

et al. (EP '126) suggests that the process of Carruthers et al. would operate effectively without using a hydrogen excess.

The mere ability to modify a disclosure does not, in and of itself, render an invention obvious. Carruthers et al. clearly discloses using a hydrogen treating rate which is greater than the hydrogen consumption rate. Nothing suggests doing otherwise. While the use of less hydrogen might reduce costs, one of ordinary skill in the art would not do so unless he knew, or had reason to believe, that it would not jeopardize the operation of the process.

Hatanaka et al. (EP '126) discloses a process for hydrodesulfurizing catalytically cracked gasoline, which contains sulfur compounds and olefins, whereby sulfur compounds are removed and reduction of the olefin content is minimized. In the process, the catalytically cracked gasoline feedstock is separated into a plurality of fractions (e.g., by distillation). At least one of these fractions is a fraction is rich in sulfur compounds that are hard to desulfurize. A second fraction is rich in sulfur compounds that are easy to desulfurize. At least one of these first and second fractions is then subjected to catalytic hydrodesulfurization (e.g., using a nickel-cobalt-molybdenum catalyst). Thereafter, the hydrodesulfurized fraction is combined with the remaining fractions. See paragraph bridging pages 2 and 3.

EP '126 lists thiophene and alkylthiophenes as sulfur compounds that are difficult to desulfurize. Conversely, EP '126 lists benzothiophene, alkylbenzothiophenes, thiacyclopentane, and alkylthiacyclopentanes as sulphur compounds that are easy to desulfurize. At page 3, lines 36-50, the EP '126 disclose the boiling points of numerous sulfur compounds that are difficult to desulfurize and numerous sulfur compounds that are easy to desulfurize. As noted by EP '126, these boiling points are often close together. For this reason, EP '126 states that it is **necessary** to first determine the sulfur compound distribution and then select an appropriate distillation system. See page 3, lines 48-50. It is also necessary to select the reaction conditions for treating each fraction based on the composition of the fractions. See page 4, lines 15-17.

The fraction that is rich in sulphur compounds that are hard to desulfurize contains more than 50 mol % of such sulphur compounds, based on the total content of sulphur compounds in the fraction. Conversely, the fraction that is rich in sulphur compounds that

are easy to desulfurize contains more than 50 mol % of such sulphur compounds based on the total content of sulphur compounds within the fraction.

In Example 1, the gasoline is divided into seven fractions or cuts, which were analyzed. The 70-80°C cut and the 80 + °C cut had high contents of sulphur compounds characterized as hard to desulfurize. These two cuts were combined together, subjected to hydrodesulfurization, and then combined with the remaining cuts. See also Example 2.

In Example 3, the feedstock was distilled into 20 cuts. The cuts were subjected to analysis and it was determined that four cuts had high contents of sulphur compounds characterized as easy to desulfurize. These four cuts were combined, subjected to hydrodesulfurization, and then combined with the remaining cuts.

In Example 4, the feedstock was again divided into 20 cuts. Four of these cuts were found, following analysis, to have high contents of sulphur compounds characterized as easy to desulfurize. In addition, other cuts were found to have high contents of sulphur compounds characterized as hard to desulfurize. These two groups of cuts were separately combined, separately subjected to hydrodesulfurization, and thereafter the two desulfurized mixtures were combined with the remaining cuts.

Example 5 illustrates an embodiment in which the catalytic cracked gasoline is distilled into two cuts i.e., a 30-100°C cut and a 100-230°C cut. Following analysis, the 100-230°C cut was found to have a high content of sulphur compounds as easy to desulfurize. This cut was subjected to hydrodesulfurization and then combined with the 300-100°C cut.

EP '126 does not disclose a process involving selective hydrogenation of a gasoline feedstock containing sulphur compounds, prior to performing a separation step, and thus does not suggest appellants' process. However, in the rejection, the Examiner argues that it would be obvious to modify the process of Carruthers et al. to incorporate the separation process of EP '126. The asserted motivation for this modification is that the sulfur content of the product of the Carruthers et al. process would be further reduced and the octane number would be maintained by minimizing reduction of olefin contents. But, the process of EP '126 is complex involving analysis of the feedstock to decide how to perform the distillation and the analysis of the resultant cuts to decide which fractions are to be

desulfurized. Merely, because sulfur reduction is desirable does not suggest the use of a very complex procedure to achieve such reduction, particularly when the process of Carruthers et al. already provides sulfur reduction and produces a product which can be used as a gasoline. Also, nothing suggests that the effluent from the Carruthers et al. process, which has been specifically treated to reduce the types of sulfur compounds present, should be subjected to a process such as disclosed in EP '126 which is directed toward treating feedstock with a wide variety of sulfur compounds present. The Carruthers et al. process reduces the types of sulphur compounds via a reduction in diolefins, i.e., by reacting diolefins with mercaptans to form thiophenes. Thus, overall, this is no motivation to modify the Carruthers et al. process so as to combine it with the complicated process of EP '126.

Moreover, even if the modification is made, the resultant modified Carruthers et al. process would still not suggest Appellants' claimed invention as recited in claims 11 and 46. EP '126 discloses separating a feedstock into a plurality of fractions wherein one fraction is rich in sulphur compounds that are characterized as hard to desulfurize whereas another fraction is rich in sulphur compounds that are easy to desulfurize. Thus, the focus of EP '126 is to provide at least two fractions, both of which are rich in sulfur compounds, albeit different types of sulfur compounds. EP '126 does not disclose separating the feedstock to provide a light fraction that contains olefins from which substantially all the sulphur compounds have been removed and a heavy fraction in which most of the sulphur compounds initially present within the gasoline feedstock are concentrated.

In addition, EP '126, like Carruthers et al., is devoid of any suggestion that would lead one to modify the Carruthers et al. process so as to perform selective hydrogenation using a hydrogen/feedstock ratio of 8-30 liters/liter. Compare, e.g., Appellants' claims 1, 29 and 30.

In view of the above remarks, it is respectfully submitted that Carruthers et al., taken above or in combination with EP '126, fails to render obvious appellants' invention.

Dependent Claims 16, 17, 21, 35-37, 38, 39, and 40

As noted above, EP '126 discloses separating a feedstock into a plurality of fractions wherein one fraction is rich in sulphur compounds that are characterized as hard to desulfurize whereas another fraction is rich in sulphur compounds that are easy to desulfurize. Neither Carruthers et al. nor EP '126 disclose separating the feedstock to provide a light fraction that contains olefins from which substantially all the sulphur compounds have been removed, and a heavy fraction in which most of the sulphur compounds initially present within the gasoline feedstock are concentrated.

While EP '126 does disclose mixing together separated fractions before and after subsequent treatments, neither Carruthers et al. nor EP '126 disclose mixing together an intermediate fraction and a heavy fraction in which most of the sulphur compounds initially present within the gasoline feedstock are concentrated before performing a catalytic treatment whereby sulfur compounds are at least partially decomposed or hydrogenated. Similarly, neither Carruthers et al. nor EP '126 disclose mixing together an intermediate fraction with the effluent from the treatment of a heavy fraction, in which most of the sulphur compounds initially present within the gasoline feedstock are concentrated, after the heavy fraction is subjected to a catalytic treatment whereby sulfur compounds are at least partially decomposed or hydrogenated. Compare Appellants' claims 16, 17, 35-37, 39, and 40

Neither Carruthers et al. nor EP '126 disclose or suggest subjecting the effluent from a selective hydrogenation to a separation to produce a light fraction containing olefins, and from which substantially all of the sulfur has been removed, a heavy fraction in which most of the sulfur compounds initially contained in the gasoline feedstock is concentrated, and at least one intermediate fraction, subjecting at least one intermediate fraction to a treatment to remove sulfur and nitrogen, and then further subjecting effluent from such a treatment to catalytic reforming. Compare Appellants' claim 21.

Carruthers et al. and EP '126 also fail to disclose or suggest subjecting the effluent from a selective hydrogenation of diolefins and acetylenic compounds to a treatment wherein the molecular weight of sulfur compounds is increased. Compare Appellants' claim 38.

Rejection under 35 USC §103 in view of Carruthers et al., EP '126, and Cecil et al.

Claims 13-15, 20, 26, 27, 36, and 41-44 are rejected as allegedly being obvious in view of Carruthers et al. (US 3,691,066), EP 0 725 126, and Cecil et al. (US 3,732,155). Appellants also respectfully traverse this rejection.

The disclosures of Carruthers et al. and EP '126 are discussed above. While EP '126 does disclose mixing together separated fractions before and after subsequent treatments, neither Carruthers et al. nor EP '126 nor Cecil et al. disclose mixing together an intermediate fraction and a heavy fraction in which most of the sulphur compounds initially present within the gasoline feedstock are concentrated before performing a catalytic treatment whereby sulfur compounds are at least partially decomposed or hydrogenated. Similarly, neither Carruthers et al. nor EP '126 nor Cecil et al. disclose mixing together an intermediate fraction with the effluent from the treatment of a heavy fraction, in which most of the sulphur compounds initially present within the gasoline feedstock are concentrated, after the heavy fraction is subjected to a catalytic treatment whereby sulfur compounds are at least partially decomposed or hydrogenated. Compare Appellants' 26 and 27.

Cecil et al. (US '155) describes a process wherein a hydrocarbon feed containing sulfur compounds is contacted with sulfur-resistant catalysts and progressively desulfurized in a combination of steps. In the initial step, the feed is contacted with catalysts while in the presence of hydrogen and thereby partially desulfurized. In a subsequent step, the feed is contacted with a catalyst, without hydrogen, and thereby desulfurized. See, Column 3, lines 1-11.

US '155 does not overcome the discrepancies in the disclosures of Carruthers et al. and EP '126, as discussed above. Nor is there any suggestion that the two-step desulphurization procedure described by US '155 would be suitable for use in treating the particular fractions obtained by the combination of Carruthers et al. and EP '126, i.e., either a fraction that is rich in sulfur compounds that are easy to desulfurize or a fraction that is rich in sulfur compounds that is hard to desulfurize. The Examiner argues that the motivation for the resultant modification is to obtain better hydrogen utilization and

efficiency. But, there is no rational as to why one would expect such advantages in treating the two particular fractions of the Carruthers et al./EP '126 combination to successive desulphurization steps. Nor is there any suggestion that two desulfurization steps are desirable, rather than one.

The examiner argues that US '155 discloses that virtually any sulfur-containing feedstock can be used in its process. This, however, does not provide motivation to modify either US '066 or EP '126. The mere ability to modify a disclosure does not, in and of itself, establish obviousness. See, e.g., *In re Laskowski*, 10 USPQ2d 1397 (Fed. Cir. 1989). Instead, there must be set forth some motivation for making the alleged modification. No sufficient motivation is presented in the rejection.

In view of the above remarks, it is respectfully submitted that Carruthers et al., taken alone or in combination with EP '126 and/or US '155, fails to render obvious Appellants' claimed invention.

Dependent Claims 20, 41 and 42

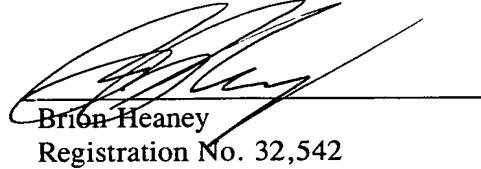
EP '126 does not disclose a process wherein a stream is separated into four fractions, i.e., a light fraction, a heavy fraction and two intermediate fractions, and wherein one of the intermediate fractions is combined with a heavy fraction in which most of the initial sulfur compounds are concentrated, before that heavy fraction is contacted with a catalyst to at least partially decomposed or hydrogenate sulfur compounds. Compare Appellants' claim 20.

Carruthers et al., EP '126 and Cecil et al. also fail to disclose or suggest subjecting the effluent from a selective hydrogenation of diolefins and acetylenic compounds to a treatment wherein the molecular weight of sulfur compounds is increased. Compare Appellants' claims 41 and 42.

(9) CONCLUSION

For all of the above reasons, it is urged that the decision of the Examiner rejecting claims 11-21 and 23-46, on appeal, is in error and should be reversed.

Respectfully submitted,



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Filed: June 22, 2004

APPENDIX OF CLAIMS ON APPEAL - SERIAL NO. 09/985,937

Listing of Claims:

Claims 1-10: (Cancelled)

11. (Previously Presented): A process of producing gasoline with a low sulfur content from a gasoline feedstock containing sulfur compounds, diolefins, olefins, aromatics, nitrogen and acetylenic compounds, said process comprising at least the following steps:

- (a1) conducting at least one selective hydrogenation of diolefins and acetylenic compounds contained in the feedstock, wherein in step (a1) the hydrogen to feedstock ratio is 8 -30 liters of hydrogen per liter of feedstock,
- (b) conducting at least one separation of effluent obtained at the end of step (a1) into at least three fractions: a light fraction containing olefins, and from which substantially all of the sulfur has been removed, a heavy fraction in which most of the sulfur compounds initially contained in the gasoline feedstock is concentrated, and at least one intermediate fraction,
- (c1) conducting at least one treatment of the heavy fraction separated at step (b) on a catalyst enabling the sulfur compounds to be at least partially decomposed or hydrogenated, and
- (d) conducting at least one step to remove sulfur and nitrogen from at least one intermediate fraction.

12. (Previously Presented): A process as claimed in claim 11, further comprising at least one step (a2) prior to step (b) of increasing the molecular weight of sulfur compounds present in at least one of the feedstock or the effluent from step (a1).

13. (Previously Presented): A process as claimed in claim 11, further comprising a step (c2) of treating effluent from step (c1) on a catalyst to decompose sulfur compounds.

14. (Previously Presented): A process as claimed in claim 13, in which the

hydrogenation of olefins in said effluent of (c1) is limited to less than 20% by volume.

15. (Previously Presented): A process as claimed in claim 13, further comprising a step (e) of mixing at least two of said fractions, at least one of which was desulfurized at step (c1) and optionally (c2), or step (d).

16. (Previously Presented): A process as claimed in claim 11, in which a part of at least one intermediate fraction obtained from step (b) is mixed with the heavy fraction from step (b) prior to step (c1).

17. (Previously Presented): A process as claimed in claim 11, in which a part of at least one intermediate fraction obtained at step (b) is mixed with effluent from step (c1).

18. (Previously Presented): A process as claimed in claim 11, in which step (d) during which sulphur and nitrogen are removed, further comprises hydrogenation of the olefins.

19. (Previously Presented): A process as claimed in claim 11, in which the feedstock is a gasoline cut from a catalytic cracking unit.

20. (Previously Presented): A process as claimed in claim 13, in which step (b) comprises separating effluent obtained from step (a1) into four fractions: a light fraction, a heavy fraction and two intermediate fractions, treating one of the intermediate fractions at step (d), and mixing the other intermediate fraction with the heavy fraction separated at step (b) before said heavy fraction is treated in step (c1) and/or step (c2).

21. (Previously Presented): A process according to claim 11, further comprising subjecting effluent from at least one intermediate fraction of step (d) to catalytic reforming.

22. (Cancelled):

23. (Previously Presented): A process according to claim 11, wherein the sulfur compounds in the gasoline feedstock comprise ethyl mercaptan, propyl mercaptan, thiophen, CS₂, dimethyl sulphide, methylethyl sulphide, or COS.

24. (Previously Presented): A process according to claim 11, wherein the sulfur compounds in the gasoline feedstock comprise compounds with a boiling point lower than thiophen.

25. (Previously Presented): A process of producing gasoline with a low sulfur content from a gasoline feedstock comprising sulfur compounds, diolefins, olefins, aromatics, nitrogen and acetylenic compounds, said process comprising at least the following steps:

- (a1) conducting at least one selective hydrogenation of diolefins and acetylenic compounds comprised in the feedstock, wherein in step (a1) the hydrogen to feedstock ratio is 8 -30 liters of hydrogen per liter of feedstock,
- (a2) increasing the molecular weight of sulfur compounds present in at least one of the feedstock or the effluent from step (a1),
- (b) conducting at least one separation of effluent obtained at the end of step (a1) or (a2) into at least three fractions: a light fraction comprising olefins, and from which substantially all of the sulfur has been removed, a heavy fraction in which most of the sulfur compounds initially comprised in the gasoline feedstock is concentrated, and at least one intermediate fraction,
- (c1) conducting at least one treatment of the heavy fraction separated at step (b) on a catalyst enabling the sulfur compounds to be at least partially decomposed or hydrogenated,
- (d) conducting at least one step to remove sulfur and nitrogen from at least one intermediate fraction, and
- (e) mixing at least two of the fractions, at least one of which was desulfurized at step (c1) or step (d).

26. (Previously Presented): A process of producing gasoline with a low sulfur content from a gasoline feedstock comprising sulfur compounds,

diolefins, olefins, aromatics, nitrogen and acetylenic compounds, said process comprising at least the following steps:

- (a1) conducting at least one selective hydrogenation of diolefins and acetylenic compounds comprised in the feedstock, wherein in step (a1) the hydrogen to feedstock ratio is 8 -30 liters of hydrogen per liter of feedstock,
- (a2) increasing the molecular weight of sulfur compounds present in at least one of the feedstock or the effluent from step (a1),
- (b) conducting at least one separation of effluent obtained at the end of step (a1) or (a2) into at least three fractions: a light fraction comprising olefins, and from which substantially all of the sulfur has been removed, a heavy fraction in which most of the sulfur compounds initially comprised in the gasoline feedstock is concentrated, and at least one intermediate fraction having a depleted content of olefins and aromatics,
- (c1) conducting at least one treatment of the heavy fraction separated at step (b) on a catalyst enabling the sulfur compounds to be at least partially decomposed or hydrogenated,
- (c2) treating effluent from step (c1) on a catalyst so as to decompose the sulfur compounds, and
- (d) conducting at least one step to remove sulfur and nitrogen from at least one intermediate fraction,
 - wherein a part of said at least one intermediate fraction obtained from step (b) is mixed with the heavy fraction prior to step (c1).

27. (Previously Presented): A process of producing gasoline with a low sulfur content from a gasoline feedstock comprising sulfur compounds, diolefins, olefins, aromatics, nitrogen and acetylenic compounds, said process comprising at least the following steps:

- (a1) conducting at least one selective hydrogenation of diolefins and acetylenic compounds comprised in the feedstock, wherein in step (a1) the hydrogen to feedstock ratio is 8 -30 liters of hydrogen per liter of feedstock,
- (a2) increasing the molecular weight of sulfur compounds present in at least one of the feedstock or the effluent from step (a1),
- (b) conducting at least one separation of effluent obtained at the end of step (a1) or

(a2) into at least three fractions: a light fraction comprising olefins, and from which substantially all of the sulfur has been removed, a heavy fraction in which most of the sulfur compounds initially comprised in the gasoline feedstock is concentrated, and at least one intermediate fraction,

(c1) conducting at least one treatment of the heavy fraction separated at step (b) on a catalyst enabling the sulfur compounds to be at least partially decomposed or hydrogenated, and mixing a part of at least one intermediate fraction obtained at step (b) with effluent from step (c1),

(c2) treating effluent from step (c1) on a catalyst so as to decompose the sulfur compounds, and

(d) conducting at least one step to remove sulfur and nitrogen from at least one intermediate fraction.

28. (Previously Presented): A process according to claim 29, further comprising increasing the molecular weight of sulfur compounds present in at least one of the feedstock or the effluent from the selective hydrogenation.

29. (Previously Presented): A process for producing gasoline with a low sulfur content from a gasoline feedstock comprising:

conducting at least one selective hydrogenation of diolefins and acetylenic compounds comprised in the feedstock, wherein in said at least one selective hydrogenation the hydrogen to feedstock ratio is 8 -30 liters of hydrogen per liter of feedstock;

separating an effluent of the at least one selective hydrogenation into at least three fractions; and

conducting at least one treatment of one of the fractions separated on a catalyst enabling the sulfur compounds to be at least partially decomposed or hydrogenated.

30. (Previously Presented): A process for producing gasoline with a low sulfur content from a gasoline feedstock comprising:

conducting at least one selective hydrogenation of diolefins and acetylenic compounds comprised in the feedstock, wherein in said at least one selective hydrogenation the hydrogen

to feedstock ratio is 8 -30 liters of hydrogen per liter of feedstock;

separating an effluent of the at least one selective hydrogenation into at least three fractions; and

removing sulfur and nitrogen from at least one of the separated fractions.

31. (Previously Presented): A process according to claim 29, wherein the fractions comprise a light fraction, an intermediate fraction, and a heavy fraction.

32. (Previously Presented): A process according to claim 30, further comprising increasing the molecular weight of sulfur compounds present in at least one of the feedstock or the effluent from the selective hydrogenation.

33. (Previously Presented): A process according to claim 30, wherein the fractions comprise a light fraction, an intermediate fraction, and a heavy fraction.

34. (Previously Presented): A process as claimed in claim 11, further comprising at least one step (a2) prior to step (b) of increasing the molecular weight of sulfur compounds present in the effluent from step (a1).

35. (Previously Presented): A process as claimed in claim 34, in which a part of at least one intermediate fraction obtained from step (b) is mixed with the heavy fraction from step (b) prior to step (c1).

36. (Previously Presented): A process as claimed in claim 26, in which a part of at least one intermediate fraction obtained at step (b) is mixed with effluent from step (c1) prior to step (c2).

37. (Previously Presented): A process as claimed in claim 34, in which step (b) comprises separating effluent obtained from step (a1) into four fractions: a light fraction, a heavy fraction and two intermediate fractions, treating one of the intermediate fractions at step (d), and mixing the other intermediate fraction with the heavy fraction separated at step (b)

before said heavy fraction is treated in step (c1) and/or step (c2).

38. (Previously Presented): A process according to claim 25, wherein step (a2) is performed on the effluent of step (a1).

39. (Previously Presented): A process as claimed in claim 38, in which a part of at least one intermediate fraction obtained from step (b) is mixed with the heavy fraction from step (b) prior to step (c1).

40. (Previously Presented): A process as claimed in claim 38, in which a part of at least one intermediate fraction obtained at step (b) is mixed with effluent from step (c1) prior to step (c2).

41. (Previously Presented): A process according to claim 26, wherein step (a2) is performed on the effluent of step (a1).

42. (Previously Presented): A process according to claim 27, wherein step (a2) is performed on the effluent of step (a1).

43. (Previously Presented): A process according to claim 13, wherein steps (c1) and (c2) are performed in a single reactor.

44. (Previously Presented): A process according to claim 13, wherein steps (c1) and (c2) are performed in two separate reactors.

45. (Previously Presented): A process according to claim 12, wherein steps (a1) and (a2) are performed simultaneously.

46. (Previously Presented): A process of producing gasoline with a low sulfur content from a gasoline feedstock containing sulfur compounds, diolefins, olefins, aromatics, nitrogen and acetylenic compounds, said process comprising at least the following steps:

- (a1) conducting at least one selective hydrogenation of diolefins and acetylenic compounds contained in the feedstock,
- (b) conducting at least one separation of effluent obtained at the end of step (a1) into at least three fractions: a light fraction containing olefins, and from which substantially all of the sulfur has been removed, a heavy fraction in which most of the sulfur compounds initially contained in the gasoline feedstock is concentrated, and at least one intermediate fraction,
- (c1) conducting at least one treatment of the heavy fraction separated at step (b) on a catalyst enabling the sulfur compounds to be at least partially decomposed or hydrogenated, and
- (d) conducting at least one step to remove sulfur and nitrogen from at least one intermediate fraction.